DESCRIPTION

ACCESS NETWORK SYSTEM, SUBSCRIBER STATION DEVICE, AND
NETWORK TERMINAL DEVICE

5

TECHNICAL FIELD

[0001]

The present invention relates to an access network system, a subscriber station device, and a network terminal device, by which a subscriber can perform communication between a subscriber terminal owned by the subscriber and a given communication network via an access network made up by a plurality of relay stations. In particular, the invention relates to an access network system, a subscriber station device, and a network terminal device, by which an access network can be made up between the subscriber terminal and an ISP (Internet Service Provider), and through which the subscriber terminal can have access to Internet via an ISP network provided by VLAN (Virtual Local Area Network; Virtual LAN) and ISP.

BACKGROUND ART

[0002]

In general, an IP network is used as an access

network to connect a subscriber terminal with an ISP. A packet transmitted from the subscriber terminal is sent to the ISP via IP tunnel. However, in the processing of encapsulation of IP packet to match IP tunnel, the load of the processing is high in a device to accommodate the subscriber terminal, and this often causes hindrance to high-speed communication.

[0003]

To solve the above problems, new techniques are described in the Patent Document 1 and the Non-Patent Document 1 as given below, in which an access network is made up with VLAN, and a device for centralized management of various types of information relating to the setting of VLAN and to traffic in the access network is provided, and route control is performed for VLAN route by this management device. According to this technique, it is possible to identify in advance a plurality of routes (redundant routes) in the access network between edge devices. Also, it is possible to conduct the route switchover caused by trouble at high speed and to improve throughput. Further, according to this technique, the problems by broadband access server can be solved when PPPoE (Point-to-Point Protocol Over Ethernet (registered trademark)) is adopted.

[0004]

On the other hand, a new technique is described in the Patent Document 2 as given below. According to this technique, in a communication system to provide communication service to make connection between two

5   different user sites by VPN (Virtual Private Network), in a hierarchical network including edge devices connected to each to two different user sites, frame of user MAC (Media Access Control) is encapsulated, and hierarchical MAC frame added with hierarchical header is

10   transmitted. In this hierarchical header, edge source address (e.g. address of physical port of entry edge device) and edge destination address (address of physical port of exit edge device) are included. A relay device in the hierarchical network can transfer

15   hierarchical MAC frame by referring to edge destination address of the hierarchical header, and it is possible to make up a VPN exceeding a preset number when using VLAN. This contributes to the improvement of scalability and working efficiency.

20   [Patent Document 1] JP-A-2003-338836 (Figs. 4 and 9)

       [Patent Document 2] JP-A-2004-32006 (Figs. 1, 2, 16

                        and 17)

       [Non-Patent Document 1] TSMMW 2002 (The 4th Topical

                        Symposium on Millimeter

25   Waves),

pp.199-202.

[0005]

However, according to the technique described in the Patent Document 1 and the Non-Patent Document 1, fixed

5   VLAN routes are allotted for each subscriber station device, which is an edge device of the access network. As a result, the connection to ISP from the subscriber station device is restricted, and there are problems in that the subscriber terminal connected to a certain

10 subscriber station device cannot freely select the ISP for connection.

[0006]

Also, according to the technique described in the Patent Document 2, a VLAN route is basically set up

15 between two different user sites. On the other hand, in case of a network configuration, in which frame transmission is carried out via a plurality of VLAN routes (by changing and adding a plurality of VLAN tags one after another), an edge device present at an edge of

20 VLAN on upstream side (ISP side terminal device) cannot acquire information relating to VLAN on downstream side, which is present with a certain VLAN interposed between them. Therefore, the ISP side cannot identify information relating to the subscriber terminal, for

25 instance, and this causes incompleteness and

dissatisfaction in providing fair services or in preventing unjust access. Also, in Nomadic environment where VLAN on downstream side can switch over the connection destination to VLAN on upstream side,

5   transmission of frame from ISP on upstream side to VLAN after moving cannot be carried out.

DISCLOSURE OF THE INVENTION

[0007]

10   To solve the above problems, it is an object of the present invention to provide an access network system, a subscriber station device, and a network terminal device, by which it is possible to freely select ISP of connection destination for each subscriber terminal

15   while maintaining various advantages when using VLAN, such as inexpensive and simple arrangement or accomplishment of high-speed communication, to ensure reliable communication between subscriber terminal and ISP, and to cope with Nomadic connection.

20   [0008]

To attain the above object, the present invention provides an access network system for making access to a given network by a subscriber terminal, said access network system comprising:

25   a first network terminal device connected to said

given network and terminating a first network for
transfer on a layer 2 level;

a second network terminal device able to put said
subscriber terminal under control and terminating a
second network for transfer on said layer 2 level; and

a subscriber station device for connecting said
first and said second networks with each other and
terminating each of said first and said second networks,
wherein:

the transmission of the frame is conducted by using
a VLAN pass identified by a VLAN tag in said second
network, and transmission of said frame added with a
frame header including said VLAN tag used in said second
network is conducted.

[0009]

Also, the present invention provides the access
network system with above arrangement, wherein, in said
first network, transmission of said frame is conducted
by using a VLAN pass identified by a VLAN tag different
from said VLAN tag used in said second network.

[0010]

Further, the present invention provides the access
network system with the above arrangement, wherein said
subscriber station device is so arranged as to generate
said VLAN tag used in said second network in response to

a request of connection to said given network from said subscriber terminal.

[0011]

Also, the present invention provides the access network system with above arrangement, wherein MAC addresses of said first network terminal device and said subscriber station device used in said first network are generated according to said VLAN tag used in said first and said second networks, and MAC addresses of said first network terminal device and said subscriber station device are set up to destination MAC address and source MAC address of said frame header.

[0012]

Further, to attain the above the above object, the present invention provides a subscriber station device included in an access network system where a subscriber terminal makes access to a given network, wherein:

a first network connected to said given network side and for performing transfer of a layer 2 level is connected to a second network connected to said subscriber terminal side and for performing transfer of said layer 2 level, and terminating each of said first and said second networks, said subscriber station device further comprises:

means for transmission of a frame using a VLAN pass

identified by a VLAN tag in said second network; and

means for adding a frame header including said VLAN tag used in said second network to a frame to be sent to said first network.

5   [0013]

Also, the present invention provides the subscriber station device with the above arrangement, wherein said VLAN tag used in said second network is generated in response to a request of connection to said given

10   network from said subscriber terminal.

[0014]

Further, the present invention provides a network terminal device included in an access network system where a subscriber terminal makes access to a given

15   network, connected to said given network and connected to a first network arranged on said subscriber terminal side, wherein said network terminal device comprises:

means for extracting a VLAN tag from a frame header, said VLAN tag being inserted in said frame header added

20   to the frame received from said first network, said VLAN tag of said second network being added to said frame in a second network passing through before being transferred in said first network; and

storage means for storing by matching said VLAN tag

25   extracted from said frame header with MAC address of

said subscriber terminal being set up as destination of said frame.

[0015]

Also, the present invention provides the network terminal device with the above arrangement, wherein said network terminal device comprises:

means for adding a frame header, including said VLAN tag matched with MAC address of said subscriber terminal and stored, to said frame when a frame addressed to said subscriber terminal is received from said given network side; and

means for sending the frame added with said frame header including said VLAN tag to said first network.

[0016]

Further, the present invention provides the network terminal device with the above arrangement, wherein a subscriber terminal makes access to a given network and being able to put said subscriber terminal under control, wherein said network terminal device comprises:

means for transmitting information to identify said given network to a subscriber station device where said subscriber terminal passes through when connecting to a given network in case a connection setup information to a given network is received from said subscriber terminal;

means for receiving a VLAN tag corresponding to connection to a given network by said subscriber terminal as a response to information to identify said given network from said subscriber station device;

5   storage means for storing by matching said VLAN tag with MAC address of said subscriber terminal;

means for adding said VLAN tag being matched with MAC address of said subscriber terminal in said arbitrary frame and stored when an arbitrary frame to be

10   sent from said subscriber terminal to a given network is received; and

means for sending the frame added with said VLAN tag to said subscriber terminal.

[0017]

15   The object of the present invention is to provide an access network system, a subscriber station device, and a network terminal device, by which it is possible to freely select ISP of connection destination for each subscriber terminal while maintaining various advantages

20   when using VLAN, such as inexpensive and simple arrangement or accomplishment of high-speed communication, to ensure reliable communication between subscriber terminal and ISP, and to cope with Nomadic connection.

25

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 is a drawing to show a network configuration in an embodiment of the present invention;

Fig. 2 is a block diagram to show an example of an arrangement of a subscriber side terminal device in the embodiment of the present invention;

Fig. 3 is a table to show an example of matching information to be stored in matching information storage means of the subscriber side terminal device in the embodiment of the present invention;

Fig. 4 is a block diagram to show an example of an arrangement of a subscriber station device in the embodiment of the present invention;

Fig. 5 is a table to show an example of the matching information to be stored in matching information storage means of the subscriber station device in the embodiment of the present invention;

Fig. 6 is a block diagram to show an example of an arrangement of an ISP side terminal device in the embodiment of the present invention;

Fig. 7 is a table to show an example of the matching information to be stored in the matching information storage means of the ISP side terminal device in the embodiment of the present invention;

Fig. 8 is a table to show an example of a format of a frame to be transmitted between the subscriber side terminal device and the subscriber terminal in the embodiment of the present invention;

5 Fig. 9 is a table to show an example of a format of a frame to be transmitted between the subscriber station device and a subscriber side terminal device in the embodiment of the present invention;

Fig. 10 is a table to show an example of a format of 10 a frame to be transmitted between the ISP side terminal device and the subscriber station device;

Fig. 11 is a table to show an example of MAC address of the ISP side terminal device to be used only in a first network in the embodiment of the present 15 invention;

Fig. 12 is a table to show an example of MAC address of the subscriber station device to be used only in a first network in the embodiment of the present invention;

20 Fig. 13 is a table to show an example of a format of a frame to be transmitted between an ISP router and the ISP side terminal device in the embodiment of the present invention;

Fig. 14 is a sequence chart of ISP authentication 25 request in the embodiment of the present invention;

Fig. 15 is a sequence chart of ISP authentication response in the embodiment of the present invention;

Fig. 16 is a sequence chart to show main signal frame transmitting and receiving in the embodiment of

5   the present invention;

Fig. 17 is a drawing to show an example, in which connection is made from a plurality of subscriber terminals under the control of the same subscriber side terminal device to different ISPs in a network

10   configuration in the embodiment of the present invention;

Fig. 18 is a drawing to show an example, in which connection is made from a plurality of subscriber terminals under the control of each of different

15   subscriber side terminal devices to different ISPs in a network configuration in the embodiment of the present invention;

Fig. 19 is a drawing to show a condition before the subscriber side terminal device changes the subscriber

20   station device 7 at connection destination in a network configuration in the embodiment of the present invention; and

Fig. 20 is a drawing to show a condition after the subscriber side terminal device changes the subscriber

25   station device 7 at connection destination in a network

configuration in the embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0019]

5   First, description will be given on general features

of an embodiment of the present invention referring to

Fig. 1. Fig. 1 is a drawing to show an arrangement of a

network in an embodiment of the present invention. Fig.

1 shows an aspect of an access network 3 between a

10   subscriber terminal 1 on the subscriber side and ISP

routers 2a and 2b on the ISP side. Hereinafter, a side

relatively closer to the ISP side may be referred as

upstream side and a side relatively closer to the

subscriber may be referred as downstream side.

15   [0020]

The access network 3 comprises a first network 4 and

a second network 5 for carrying out transfer at a layer

2 level, and communication between the subscriber and

the ISP is performed via the first network 4 and the

20   second network 5. Here, the communication is performed

via two networks, i.e. the first network 4 and the

second network 5, while the communication may be made

via more number of networks. Also in the second network

5, a relay station device may be present between a

25   subscriber side terminal device 9 and a subscriber

station device 7, and a mere wired link or a wireless link may be used between the subscriber side terminal device 9 and the subscriber station device 7. In the present specification, a network between the subscriber side terminal device 9 and the subscriber station device 7 is referred as the second network 5 for convenience even in case a relay station device is present between the subscriber side terminal device 9 and the subscriber station device 7 or in case these are connected by a mere link. Specifically, it is understood that a link connection is also included in the term "the second network 5" in addition to the so-called network connection.

[0021]

In Fig. 1, an ISP side terminal device 6 is provided as an edge device on upstream side and the subscriber station device 7 is provided as an edge device on downstream side in the first network 4. Further, a plurality of relay station devices 8a – 8d are arranged between the ISP side terminal device 6 and the subscriber station device 7. In Fig. 1, one each of the ISP side terminal device 6 and the subscriber station device 7 is shown, while there may be two or more of these devices. Similarly, four relay station devices 8a – 8d are shown in Fig. 1, while there may be provided

any number of relay station devices as desired.

[0022]

Also, in Fig. 1, the subscriber station device 7 is
arranged as an edge device on upstream side and the
subscriber side terminal device 9 is arranged as an edge
device on downstream side in the second network 5.
Further, a plurality of relay station devices 8a - 8d
are provided between the ISP side terminal device 6 and
the subscriber station device 7. As described above, the
subscriber station device 7 acts as an edge device on
upstream side of the second network 5 and also as an
edge device on downstream side of the first network 4.
Namely, the subscriber station device 7 plays a role of
a connection point between the first network 4 and the
second network 5.

[0023]

Fig. 1 shows how a single subscriber side terminal
device 9 is connected to a single subscriber station
device 7, while it is possible to connect a plurality of
subscriber side terminal devices 9 to a single
subscriber station device 7. Also, in Fig. 1, it is
shown as if the subscriber station 7 is directly
connected with the subscriber side terminal device 9.
However, similarly to the case of the first network 4,
it is possible to arrange any number of relay station

devices as desired between the subscriber station device 7 and the subscriber side terminal device 9. For example, the subscriber station device 7 is a device to accommodate a plurality of subscriber side terminal devices 9 existing in a building, and the subscriber side terminal device 9 is a device to accommodate a plurality of subscriber terminals 1 existing on each floor within the building.

[0024]

Further, the first network 4 is made up by VLAN between L2 switches. Specifically, in the first network 4, a VLAN pass is built up between L2 switches by using a remote tag in advance between the edge device on upstream side and the edge device on downstream side, and frame transfer is conducted so that the frame flows through a predetermined pass by using a VLAN tag added to the frame. In the first network 4, a VLAN tag to be added to the frame is referred as a remote tag. In the first network 4, a plurality of redundant routes can be built up between the same edge devices. This redundant route may be used as an alternative route or may be used for the control of load balance and QoS (Quality of Service) policy.

[0025]

By normal procedure using the conventional technique,

it is not easy for the ISP side terminal device 6 to
identify the information present on a side more
downstream than the subscriber station device 7 (e.g.
information of the link in the second network 5 or

5   information relating to the subscriber terminal 1).
However, according to the present invention, as shown in
the right side of Fig. 1 it is possible to encapsulate
the frame transmitted from downstream side to upstream
side as it is transmitted from the subscriber to ISP

10   within the first network 4, and by inserting a local tag
in the second network 5 with the encapsulation header,
the ISP side terminal device 6 can identify the
information, which is present on more downstream side
than the subscriber station device 7. Hereinafter, the

15   VLAN tag added to the frame within the second network 5
is referred as "a local tag".

[0026]

Specifically, as shown in Fig. 1, it is so arranged
that an encapsulation header can be added, in which a

20   local tag in the second network 5 relating to the
subscriber terminal 1, serving as destination or source,
is inserted in the frame transmitted in the first
network 4 (in particular, a frame from downstream to
upstream). As a result, it is possible, for instance,

25   that a local tag added at the second network 5 is

transmitted together with the frame in the first network 4 and the ISP side terminal device 6 can acquire the local tag added in the second network 5.

[0027]

Because the ISP side terminal device 6 can acquire the local tag added in the second network 5, various effects can be provided. For example, upon receipt of the encapsulated frame flowing from upstream to downstream within the first network 4, the subscriber station device can send the frame added with an adequate local tag to the second network 5 by merely analyzing the information in the encapsulation header. In so doing, it is possible to alleviate the burden of the processing by the subscriber station device 7.

[0028]

Also, by using two VIDs (remote tag and local tag) on the matching information for mapping, the ISP side terminal device 6 can specify the subscriber terminal 1 connected to the subscriber side terminal device 9, and the number of the subscriber terminals 1 receiving the service can be identified on the ISP side. This can be made possible from the following reasons: The ISP side terminal device 6 can specify the subscriber station device 7 from the remote tag. From the local tag used by the subscriber station device 7 thus specified, the

subscriber side terminal device 9 can be specified.

Because MAC address of the subscriber terminal 1 is also

stored in the ISP side terminal device 6, the mapping

with different MAC addresses shows that different

5   subscriber terminals 1 (a plurality of subscriber

terminals 1) are connected to a single subscriber side

terminal device 9 despite of the fact that the remote

tag and the local tag are the same. As a result, the ISP

side terminal device 6 can identify the number of

10 subscriber terminals 1 connected to the subscriber side

terminal device 9.

[0029]

In the above, description has been given on general

features of the embodiment of the present invention.

15 Next, description will be given on the details of the

embodiment of the invention. Referring to Fig. 2 to Fig.

7, description will be given on an arrangement of the

ISP side terminal device 6, the subscriber station

device 7, and the subscriber side terminal device 9.

20   [0030]

Fig. 2 is a block diagram to show an example of an

arrangement of the subscriber side terminal device in

the embodiment of the present invention. The subscriber

side terminal device 9 comprises an upstream side

25 transmitter/ receiver 901, a downstream side

transmitter/receiver 902, a connection request

processing unit 903, a connectivity establishment

notifying unit 904, a matching information storage means

905, a local tag adding unit 906, and a local tag

5   deleting unit 907. Among these, the connection request

processing unit 903 and the connectivity establishment

notifying unit 904 are the component elements necessary

for the authentication processing as described later.

[0031]

10   The upstream side transmitter/receiver 901 is an

interface, which enables transmitting and receiving of

the frame to and from the second network 5, and the

downstream side transmitter/receiver 902 is an interface,

which enables transmitting and receiving of the frame to

15   and from the subscriber. In Fig. 2, to facilitate the

explanation, the interface to transmit and receive the

frame is divided to the upstream side

transmitter/receiver 901 and the downstream side

transmitter/receiver 902, while the upstream side

20   transmitter/receiver 901 and the downstream side

transmitter/receiver 902 can be provided by the same

interface. Also, the upstream side transmitter/receiver

901 and the downstream side transmitter/receiver 902

comprise a plurality of input/output ports. For instance,

25   these have also the functions such as supervision of

input port or control of output port to enable the adding of adequate local tag. Here, it is understood that these functions are included in the upstream side transmitter/ receiver 901 and the downstream side

5 transmitter/receiver 902, and the details are not shown in the figure.

[0032]

The connection request processing unit 903 is the means for performing the processing of information

10 relating to the setting of connection to ISP to be received from the subscriber terminal 1 when the subscriber terminal 1 requests authentication to ISP. For instance, when the connection request processing unit 903 receives information relating the setting of

15 connection from the subscriber terminal 1 to ISP, MAC address of the subscriber terminal 1, transmitting the connection setting to ISP, is outputted to the matching information storage means 905, and the connection setting to ISP received from the subscriber terminal 1

20 is transmitted to the subscriber station device 7 as a connection request to ISP.

[0033]

The connectivity establishment notifying unit 904 is the means to perform the processing on the local tag

25 allotted by the subscriber station device 7 according to

the connection request to ISP. For instance, when a notification of the local tag allotted by the subscriber station device 7 according to the connection request to ISP is received, the local tag is outputted to the

5 matching information storage means 905, and it is notified to the subscriber terminal 1 that the connectivity with the subscriber station device 7 has been established.

[0034]

10 Also, the matching information storage means 905 is information storage medium to store the matching information to indicate the matching relation between the MAC address of the subscriber terminal 1 and the local tag. Specifically, as shown in Fig. 3, for example,

15 according to MAC address of the subscriber terminal 1 to transmit the connection setting to ISP and to connection request to the ISP to correspond to the connection setting to ISP, the matching relation with the local tag allotted by the subscriber station device 7 is stored in

20 the matching information storage means 905 as the matching information. In Fig. 3, the matching of MAC address of the subscriber terminal 1 [MAC address #A] and the local tag [LT1] and the matching of MAC address of the subscriber terminal 1 [MAC address #B] and the

25 local tag [LT2] are schematically shown in the condition

stored as the matching information.

[0035]

The local tag adding unit 906 is the means for referring the matching relation stored in the matching information storage means 905 and for transmitting it by adding an adequate local tag to a frame received from downstream side so that the transfer by VLAN tag can be conducted in the second network 5 on upstream side. The local tag deleting means 907 is the means for deleting the local tag of the frame transmitted with the local tag and for transmitting the frame after deleting the local tag to the subscriber terminal 1 on downstream side.

[0036]

Fig. 4 is a block diagram to show an example of an arrangement of the subscriber station device in the embodiment of the present invention. The subscriber station device 7 comprises an upstream side transmitter/receiver 701, a downstream side transmitter/receiver 702, a connection request processing unit 703, a local tag generating unit 704, a remote tag storage unit 705, a matching information storage means 706 a local tag deleting unit 707, an encapsulation unit 708, a decapsulation unit 709, and a local tag adding unit 710. The connection request processing unit 703 and the local

tag generating unit 704 are the component elements
necessary only for the authentication processing as
described later.

[0037]

5   The upstream side transmitter/receiver 701 is an
interface, which enables transmitting and receiving of
the frame to and from the first network 4, and the
downstream side transmitter/receiver 702 is an interface,
which enables transmitting and receiving of the frame to
10   and from the second network 5. In Fig. 4, to facilitate
the explanation, the interface to transmit and receive
the frame is divided to the upstream side
transmitter/receiver 701 and the downstream side
transmitter/receiver 702, while the upstream side
15   transmitter/receiver 701 and the downstream side
transmitter/receiver 702 can be provided by the same
interface. Also, the upstream side transmitter/receiver
701 and the downstream side transmitter/receiver 702 are
made up together by a plurality of input/output ports
20   and have the functions such as supervision of input port
or control of output port for adding of the adequate
local tag. Here, it is understood that these functions
are included in the upstream side transmitter/receiver
701 and the downstream side transmitter/receiver 702,
25   and the details are not shown in the figure.

[0038]

The connection request processing unit 703 is the means for performing processing of information relating to connection setting to ISP received from the subscriber side terminal device 9 when the subscriber terminal 1 requests authentication to ISP. For instance, when the connection request processing unit 703 receives information relating to the connection request to ISP from the subscriber side terminal device 9, a request for local tag generation is given to the local tag generating unit 704, and a local tag specific for the request of connection to ISP is acquired, and the local tag is notified to the subscriber side terminal device 9. Further, based on the connection request to ISP, the subscriber terminal 1 specifies the ISP, to which connection is desired. A pass in the first network 4 to connect to ISP (a pass identified by the remote tag) is found. A remote tag to identify this pass is matched with a local tag generated at the local tag generating unit 704, and this is stored in the matching information storage means 706.

[0039]

The local tag generating unit 704 is the means for generating the local tag when a request of local tag generation is received from the connection request

processing unit 703. It is desirable that different
values are set for each connection request to ISP by the
subscriber terminal 1 on the local tag. For instance,
the subscriber station device 7 can create random

5 numbers and can generate the local tag at random
according to the random numbers.

[0040]

The remote tag storage unit 705 is information
storage medium where remote tags to specify the pass

10 determined in advance in the first network 4 are stored.
In the first network 4, each of the relay station
devices 8a – 8d is so arranged that transfer processing
is performed according to the remote tag added to the
frame, and the remote tag is set in advance through

15 matching with the pass between the ISP side terminal
device 6 and the subscriber station device 7.

[0041]

The matching information storage means 706 is
information storage medium for storing the matching

20 relation between the remote tag relating to the pass up
to the ISP side terminal device 6 existing on a route to
ISP, to which the subscriber terminal 1 wants the
connection, and the local tag generated by the local tag
generating unit 704. For instance, Fig. 5 is a

25 schematical drawing of the matching information in the

matching information storage means 706. In Fig. 5, the matching between the remote tag [RT1] and the local tag [LT1] and the matching between the remote tag [RT2] and the local tag [LT2] are stored as the matching

5 information.

[0042]

The local tag deleting unit 707 is the means for deleting a local tag of a frame transferred with the local tag in the second network 5 on downstream side.

10 The encapsulation unit 708 is the means for adding a frame header (encapsulation header) generated from the matching information of the remote tag and the local tag accommodated in the matching information storage means 706 to the frame whose local tag has been deleted by the

15 local tag deleting unit 707. At the encapsulation unit 708, the processing to add the remote tag (for transfer in the first network 4) to the frame is also performed, and the frame encapsulated and added with a remote tag is sent to the first network 4 on upstream side via the

20 upstream side transmitter/receiver 701.

[0043]

The decapsulation unit 709 is the means for carrying out the processing to remove the encapsulation header of the encapsulated frame received from the first network 4

25 on upstream side. The local tag adding unit 710 is the

means for adding an adequate local tag to the frame so that the frame can be transferred in the second network 5 on downstream side. By acquiring information of the remote tag inserted in the encapsulation header from the decapsulation unit 709 and by referring to the matching information stored in the matching information storage means 706, the local tag adding unit 710 can acquire and add an adequate local tag to the frame. Because the information of the local tag is included in the encapsulation header removed at the decapsulation unit 709, the local tag adding unit 710 can also acquire the information of the local tag in the encapsulation header in the decapsulation unit 709 and can add this local tag to the frame. In particular, the acquisition of the information of the local tag in the encapsulation header and addition of the local tag to the frame alleviate the burden of the processing of the subscriber station device 7. Also, the extraction of the local tag from the encapsulation header and the addition of it to the frame are effective in case there are a multiple of local tags (e.g. a multiple of the subscriber terminals 1) and a plurality of local tags are set in overlapping to a single remote tag.

[0044]

Fig. 6 is a block diagram to show an example of an

arrangement of an ISP side terminal device in the
embodiment of the present invention. The ISP side
terminal device 6 comprises an upstream side
transmitter/receiver 601, a downstream side

5   transmitter/receiver 602, a pseudo-header analyzing unit
603, a matching information storage means 604, a
decapsulation unit 605, and an encapsulation unit 606.
Although not shown in the figure, similarly to the case
of the subscriber station device 7, the ISP side

10 terminal device 6 may have a remote tag storage unit
where information of the pass in the first network 4
(information of the remote tag) is stored in advance.

[0045]

The upstream side transmitter/receiver 601 is an

15 interface, which enables transmitting and receiving of
the frame to and from the ISP side, and the downstream
side transmitter/receiver 602 is an interface, which
enables transmitting and receiving of the frame to and
from the first network 4. To facilitate the explanation,

20 the interface to transmit and receive the frame is
divided to the upstream side transmitter/receiver 601
and the downstream side transmitter/receiver 602 in Fig.
6, while the upstream side transmitter/receiver 601 and
the downstream side transmitter/receiver 602 can be

25 provided by the same interface. The upstream side

transmitter/receiver 601 and the downstream side

transmitter/receiver 602 comprise a plurality of

input/output ports. For instance, these have the

functions such as supervision of input port for adding

5   adequate local tag or control of output port. Here, it

is understood that these functions are included in the

upstream side transmitter/receiver 601 and the

downstream side transmitter/receiver 602, and the

details are not shown in the figure.

10   [0046]

The pseudo-header analyzing unit 603 is the means

for analyzing the encapsulation header when an

encapsulated frame is received from the first network 4.

When a frame relating to an encapsulated ISP

15   authentication request is received from the first

network 4 in the authentication processing, for instance,

the pseudo-header analyzing unit 603 acquires

information on the local tag and the remote tag from the

encapsulation header and further acquires MAC address of

20   the subscriber terminal 1. By matching these types of

information with each other, these can be outputted to

the matching information storage means 604. Also, the

pseudo-header analyzing unit 603 outputs the

encapsulated frame to the decapsulation unit 605. After

25   the encapsulation header is removed at the decapsulation

unit 605, the encapsulated frame is sent to the ISP side via the upstream side transmitter/receiver 601.

[0047]

The matching information storage means 604 is information storage medium for storing the matching information to indicate the matching relation of MAC address, the remote tag and the local tag of the subscriber terminal 1 supplied from the pseudo-header analyzing unit 603. For instance, Fig. 7 schematically shows the matching information in the matching information storage means 604. In Fig. 7, the matching of [MAC address #A] (i.e. MAC address of the subscriber terminal 1), the remote tag [RT1] and the local tag [LT1], and the matching of [MAC address #B] (i.e. MAC address of the subscriber terminal 1), the remote tag [RT2], and the local tag [LT2], are shown as these are stored as the matching information.

[0048]

The decapsulation unit 605 is the means for removing the encapsulation header of the encapsulated frame received from the first network 4 such as a frame relating to ISP authentication request or a main signal frame and for generating the frame to send to the ISP side. The encapsulation unit 606 is the means for adding the encapsulation header including the remote tag and

the local tag having the matching relation with MAC

address of the subscriber terminal 1 to the frame based

on the matching information stored in the matching

information storage means 604 by referring to MAC

5   address of destination of the frame (MAC address of the

subscriber terminal 1) when the frame is received from

the ISP side (upstream side). In the encapsulation unit

606, a remote tag for transfer in the first network 4 is

added to the encapsulated frame, and the encapsulated

10   frame added with the remote tag is sent to the first

network 4 on downstream side via the downstream side

transmitter/receiver 602.

[0049]

Next, concrete description will be given on an

15   example of a format of a frame to be transmitted between

the subscriber side and the ISP side. Fig. 8 shows an

example of a format of a frame to be transmitted between

the subscriber side terminal device and the subscriber

terminal in the embodiment of the present invention. As

20   shown in Fig. 8, the frame to be transmitted between the

subscriber side terminal device 9 and the subscriber

terminal 1 has a format of destination MAC address,

source MAC address, data, and FCS (Frame Check Sequence).

The frame shown in Fig. 8 has the same format as the

25   standard frame format. Hereinafter, it is called "an

original frame". In Fig. 8, a format of a frame to be

transmitted from the subscriber terminal 1 to the

subscriber side terminal device 9 is shown, in which

"ISP router #1" is set up as the destination MAC address

5 and "subscriber terminal #1" is set up as the source MAC

address, while it is the same in the format of the frame

to be transmitted from the subscriber side terminal

device 9 to the subscriber terminal 1. In the latter

case, MAC address of the subscriber terminal 1 is set up

10 as the destination MAC address, and MAC address of the

ISP routers 2a and 2b is set up as the source MAC

address.

[0050]

Fig. 9 shows an example of a format of a frame to be

15 transmitted between the subscriber station device and

the subscriber side terminal device in the embodiment of

the present invention. As shown in Fig. 9, the frame to

be transmitted between the subscriber station device 7

and the subscriber side terminal device 9 has the format

20 of destination MAC address, source MAC address, local

tag (e.g. VID = 100), data, and FCS. This is the same as

the format of the frame in the standard VLAN, and frame

transmission based on the local tag is performed in the

second network 5. In Fig. 9, a format of a frame is

25 shown, which is transmitted from the subscriber station

device 7 to the subscriber side terminal device 9, in
which "ISP router #1" is set up as the destination MAC
address and "subscriber terminal #1" is set up as the
source MAC address, while the format of the frame to be

5   transmitted from the subscriber side terminal device 9
to the subscriber station device 7 is the same. In the
latter case, MAC address of the subscriber station
device 7 is set up as the destination MAC address, and
MAC address of the subscriber side terminal device 9 is

10   set up as the source MAC address.

     [0051]

     Fig. 10 shows an example of a format of a frame to
be transmitted between the ISP side terminal device and
the subscriber station device in the embodiment of the

15   present invention. As shown in Fig. 10, the frame to be
transmitted between the ISP side terminal device 6 and
the subscriber station device 7 has a format, in which
an expanded frame header (encapsulation header) is added
to the original frame as shown in Fig. 8. This

20   encapsulation header has a format of the destination MAC
address, the source MAC address, and remote tag (e.g.
VID = 1), and frame transmission based on the remote tag
is performed in the first network 4.

     [0052]

25   This encapsulation header is preferably a frame

header in accordance with a standard Ethernet (registered trademark) frame header. As a result, the relay station devices 8a - 8d within the first network 4 to transmit the encapsulated frame can simply perform the processing of VLAN frame with a standard tag. Thus, the relay station devices 8a - 8d to be arranged in the first network 4 can be made up by the devices, which are used for conventional processing.

[0053]

Fig. 10 shows a format of a frame to be transmitted from the ISP side terminal device 6 to the subscriber station device 7, in which "the ISP side terminal device" is set up as destination MAC address of the encapsulation header and "the subscriber station device" is set up as source MAC address. The same applies to the format of the frame to be transmitted from the subscriber station device 7 to the ISP side terminal device 6. In this case, MAC address of the subscriber station device 7 is set up as the destination MAC address, and MAC address of the ISP side terminal device 6 is set up as the source MAC address.

[0054]

Also, as MAC address of the ISP side terminal device 6 and the subscriber station device 7 to be set up as the destination MAC address and the source MAC address

to the encapsulation header as shown in Fig. 10, unique
MAC address (private address) to be used only in the
first network 4 can be used. Description will be given
below on MAC address of the ISP side terminal device 6

5   and the subscriber station device 7 referring to Fig. 11
and Fig. 12.

[0055]

Fig. 11 shows an example of MAC address of the ISP
side terminal device used only in the first network in

10 the embodiment of the present invention. For instance,
as shown in Fig. 11, the ISP side terminal device 6 to
be used only in the first network 4 has 48 bits
similarly to normal MAC address. In the foremost 8 bits,
a value "0x02" showing a private address is set up. In

15 the next 2 octets, arbitrary values (such as "0x00",
"0x01") are set up. In the subsequent 12 bits, 12 bits
of VID of the remote tag are set up. As the final 12
bits, 12 bits of VID of the local tag are set up.

[0056]

20 On the other hand, Fig. 12 shows an example of MAC
address of a subscriber station device to be used only
in the first network in the embodiment of the present
invention. For instance, as shown in Fig. 12, the
address of a subscriber station device 7 to be used only

25 in the first network 4 has 48 bits. In the foremost 8

bits, a value of "0x02" to indicate a private address is set up, and arbitrary values (such as "0x00" or "0x02") are set up in the subsequent two octets. Also, 12 bits of VID of the remote tag is set up in the subsequent 12

5   bits, and 12 bits of VID of the local tag are set up in the final 12 bits.

[0057]

As it is evident when it is referred to the private address of the ISP side terminal device 6 and the

10   subscriber station device 7 as shown in Fig. 11 and Fig. 12, both the remote tag and the local tag are used in the private address of the ISP side terminal device 6 and the subscriber station device 7, and the remote tag and the local tag are inserted as MAC addresses in the

15   encapsulation header. Also, it is possible to identify the ISP side terminal device 6 and the subscriber station device 7 only when the values of the two octets are different.

[0058]

20   Fig. 13 shows a format of a frame to be transmitted between the ISP router and the ISP side terminal device in the embodiment of the present invention. As shown in Fig. 13, the frame transmitted between the ISP routers 2a and 2b and the ISP side terminal device 6 is the same

25   as the original frame shown in Fig. 8.

[0059]

Next, description will be given on the details of processing when communication is performed by using the above arrangement and the frame format in the network configuration shown in Fig. 1. In order that the subscriber terminal 1 performs communication with an external network such as Internet via ISP (i.e. transmitting and receiving of main signal frame), authentication processing must be performed so that the subscriber terminal 1 receives authentication from ISP. Now, description will be given below on this authentication processing, referring to Figs. 14 and 15.

[0060]

Fig. 14 is a sequence chart of ISP authentication request in the embodiment of the present invention. Here, description will be given on authentication processing when the subscriber terminal 1 is newly connected to the subscriber side terminal device 9, and the subscriber terminal 1 requests connection to an external network such as Internet via the ISP as desired.

[0061]

In Fig. 14, to the subscriber side terminal device 9, the subscriber terminal 1 performs connection setting to ISP (e.g. transmission of information to identify ISP, to which it is wanted to connect) (Step S101). The

subscriber side terminal device 9 receives connection

setting to ISP from the subscriber terminal 1, and MAC

address of the subscriber terminal 1 transmitting the

connection setting (e.g. referring to source MAC address,

5   which is set up in the frame relating to connection

setting) is stored (Step S103). The storage of MAC

address in this Step S103 is only temporary, and MAC

address is maintained at least up to the completion of

the processing of Step S111 as described later.

10   [0062]

Then, the subscriber side terminal device 9

transmits a request of connection to the ISP relating to

the subscriber terminal 1 to the subscriber station

device 7 (Step S105). The request of connection to ISP

15   to be transmitted in this Step S105 is a processing to

notify from the subscriber side terminal device 9 to the

subscriber station device 7 that the subscriber terminal

1 to request the connection to a specific ISP is present

under the control and that allotment of the local tag is

20   requested to this subscriber terminal 1.

[0063]

The subscriber station device 7 receives the request

of connection to ISP from the subscriber side terminal

device 9. For instance, a random number is generated,

25   and a new local tag including the random number is

generated (Step S107), and this local tag is notified to the subscriber side terminal device 9 (Step S109). This local tag is a VLAN tag in the second network 5. It is desirable that it is newly generated each time the subscriber terminal 1 wants to make connection to the ISP as desired. Specifically, it is desirable that the local tag is generated each time the subscriber terminal 1 establishes connection with the ISP.

[0064]

Upon receipt of the notification of the local tag from the subscriber station device 7 by the subscriber side terminal device 9, the matching of MAC address of the subscriber terminal 1 stored in Step S103 with the local tag is stored in the matching information storage means 905 (Step S111), and it is notified to the subscriber terminal 1 that the connectivity with the subscriber station device 7 has been established (Step S113).

[0065]

Also, the subscriber station device 7 specifies the ISP, to which the subscriber terminal 1 is trying to make connection by referring to the request of connection to the ISP from the subscriber side terminal device 9. Then, a remote tag (a VLAN tag in the first network 4) is acquired, which determines a pass as set

up in advance in the pass to the ISP side terminal
device 6, which enables the connection to the ISP (a
pass set up in advance in the first network 4). Then,
the subscriber station device 7 performs the matching of

5 the local tag generated in Step S107 with the remote tag
to determine the pass to the ISP side terminal device 6
relating to ISP, to which the subscriber terminal is
trying to make connection. By storing the matching in
the matching information storage means 706, the matching

10 relation is stored (Step S115).

[0066]

By the processing as described in the Steps S101 –
S115, the pass relating to the subscriber terminal 1
(the pass specified by the local tag) is established

15 between the subscriber station device 7 and the
subscriber side terminal device 9 when there is a
subscriber terminal 1, which newly tries to make
connection to ISP under the control of the subscriber
side terminal device 9.

20 [0067]

Next, after confirming the establishment of the
connectivity with the subscriber station device 7 in
Step S113, the subscriber terminal 1 requests ISP
authentication (e.g. transmission of authentication

25 information to establish the connectivity with ISO, to

which it wants to make connection) to the subscriber side terminal device 9 (Step S121).

[0068]·

The subscriber side terminal device 9 receives ISP authentication request from the subscriber terminal 1 and acquires a corresponding local tag from MAC address of the subscriber terminal 1 by referring to the matching information storage means 905. After adding this local tag to the frame relating to the ISP authentication request (Step S123), the ISP authentication request with the local tag is transmitted to the subscriber station device 7 (Step S125). In this case, the format of the frame flowing from the subscriber side terminal device 9 to the subscriber station device 7 in Step S125 is the one as shown in Fig. 9, for instance.

[0069]

Upon receipt of the ISP authentication request with the local tag from the subscriber side terminal device 9, the subscriber station device 7 removes the local tag for transmission in the second network 5 from the received frame (Step S126). Then, by referring to the matching relation between the local tag and the remote tag in the matching information storage means 706 stored in Step S115, encapsulation of the frame is performed

after the local tag is removed by the frame header

(encapsulation header) using the local tag and the

remote tag (Step S127). Then, the encapsulated ISP

authentication request is transmitted to the ISP side

5 terminal device 6 (Step S129). The subscriber station

device 7 generates and stores the encapsulation header

from the local tag and the remote tag in advance, and

the encapsulation header stored in advance may be added

at the encapsulation of the frame. Also, the

10 encapsulation header using the local tag and the remote

tag may be generated in response to the receiving of the

frame. In this case, the format of the frame flowing

from the subscriber station device 7 to the ISP side

terminal device 6 in Step S125 is the one shown in Fig.

15 10, for instance.

[0070]

Upon receipt of the encapsulated ISP authentication

request from the subscriber station device 7, the ISP

side terminal device 6 performs the matching of the MAC

20 address, the local tag, and the remote tag of the

subscriber terminal 1 inserted in the encapsulation

header. By storing this in the matching information

storage means 604, the matching relation is stored (Step

S131). Then, the encapsulated frame is decapsulated

25 (Step S133), and the frame after decapsulation (the same

as the frame transmitted to the subscriber side terminal device from the subscriber terminal 1) is transmitted toward a management network (a predetermined ISP router 2a) of the predetermined ISP (Step S135).

[0071]

By the processing of Steps S121 - S135, the ISP side terminal device 6 can receive ISP authentication request from the subscriber terminal 1 and can acquire and maintain the local tag, which can identify the pass relating to the subscriber terminal 1 in the second network 5. Also, by arranging that the local tag is generated each time the connection request is made to ISP of the subscriber terminal 1, the ISP side terminal device 6 can specify the subscriber side terminal device 9, which places a predetermined subscriber terminal 1 under control or can identify the number of the subscriber terminals 1 connected to the ISP. Here, it is so arranged that the local tag is allotted when authentication request is sent from the subscriber terminal 1 to the ISP, while it can also be so arranged that the local tags are allotted in response to arbitrary information from the subscriber terminal 1.

[0072]

Next, description will be given on the processing in case authentication processing is performed on the ISP

side in response to the authentication request as shown

in Fig. 14 and the result of authentication is sent to

the subscriber from the ISP side by referring to Fig. 15.

Fig. 15 is a sequence chart of ISP authentication

5　response in the embodiment of the present invention.

[0073]

After authentication processing is performed by an

ISP authentication server (not shown) upon receipt of

the ISP authentication request as sent in Step S135 of

10　Fig. 14, the result of the authentication is sent to the

ISP side terminal device 6 as a response of the ISP

authentication (Step S201). The ISP side terminal device

6 receives the ISP authentication response from the ISP

router 2a on the ISP side. By referring to the matching

15　relation of the MAC address, the local tag, and the

remote tag in the matching information storage means 604

(matching information stored in Step S115 of Fig. 14),

the matching of the remote tag and the local tag is

determined from the destination MAC address of the frame

20　relating to the ISP authentication response (MAC address

of the subscriber terminal 1) (Step S203). By the frame

header (encapsulation header) using the local tag and

the remote tag determined in Step S203, the ISP side

terminal device 6 performs encapsulation of the frame

25　relating to the ISP authentication response (Step S205),

and the encapsulated ISP authentication response is transmitted to the subscriber station device 7 (Step S207).

[0074]

It may be so arranged that the ISP side terminal device 6 generates and stores the encapsulation header in advance from the local tag and the remote tag, and the encapsulation header stored in advance is added in case of the frame encapsulation. Also, it may be so arranged that the encapsulation header using the local tag and the remote tag is generated in response to the receiving of the frame. In this case, the format of the frame flowing from the ISP side terminal device 6 to the subscriber station device 7 in Step S207 is the one as shown in Fig. 10, for instance.

[0075]

Upon receipt of the encapsulated ISP authentication response from the ISP side terminal device 6, the subscriber station device 7 performs decapsulation of the encapsulated frame (Step S209). Then, the local tag to match the subscriber terminal 1 is added to the decapsulated frame (Step S211), and an ISP authentication response with local tag is transmitted to the subscriber side terminal device 9 (Step S213). By referring to the matching information stored in the

matching information storage means 706, the subscriber station device 7 can also acquire the local tag to be added to the decapsulated frame. By analyzing the encapsulation header added to the encapsulated frame thus received, it is also possible to acquire the local tag to be added to the frame after decapsulation. In this case, the format of the frame flowing from the subscriber station device 7 to the subscriber side terminal device 9 in Step S213 is the one shown in Fig. 9, for instance.

[0076]

Upon receipt of the ISP authentication response with local tag from the subscriber station device 7, the subscriber side terminal device 9 removes the local tag for transfer in the second network 5 from the received frame (Step S215) and transmits the frame after removing the local tag (the same as the frame transmitted from the ISP router 2a to the ISP side terminal device 6) to the subscriber terminal 1 as set at destination of the ISP authentication response (Step S217).

[0077]

By the processing of Steps S201 - S217, it is possible for the ISP side terminal device 6 to transmit the ISP authentication response while reliably identifying the subscriber terminal 1, to which the ISP

authentication response should be transmitted (i.e. the subscriber terminal 1, to which the ISP authentication request has been transmitted). Also, by analyzing the encapsulation header added to the encapsulated frame thus received, the subscriber station device 7 can also acquire the local tag to be added to the frame after decapsulation. In this case, the burden of the processing of the subscriber station device 7 can be extensively alleviated in comparison with the case where the processing to specify the local tag is performed by referring to the matching information stored in the matching information storage means 706.

[0078]

Next, description will be given on the processing in the case where the authentication processing is performed on the ISP side in response to the authentication processing shown in Fig. 14 and Fig. 15, and the result of the authentication is sent to the subscriber from the ISP side by referring to Fig. 16. Fig. 16 is a sequence chart of main signal frame transmitting/receiving in the embodiment of the present invention.

[0079]

When the authentication processing to the ISP has been successfully performed and connection can be made

to an external network such as Internet via ISP, the subscriber terminal 1 transmits a main signal to the subscriber side terminal device 9 (Step S301). The subscriber side terminal device 9 receives the main

5   signal from the subscriber terminal 1 and acquires a matching local tag from MAC address of the subscriber terminal 1 by referring to the matching information storage means 905. After adding this local tag to the main signal frame (Step S303), the main signal with

10   local tag is transmitted to the subscriber station device 7 (Step S305). In this case, the format of the main signal frame flowing from the subscriber side terminal device 9 to the subscriber station device 7 in Step S303 is the one shown in Fig. 9, for instance.

15   [0080]

Upon receipt of the main signal with local tag from the subscriber side terminal device 9, the subscriber station device 7 removes the local tag from the received main signal frame (Step S306). By the frame header

20   (encapsulation header) using the local tag and the remote tag, the encapsulation of the frame is performed after the removal of local tag by referring to the matching relation of the local tag and the remote tag stored in the matching information storage means 706

25   (Step S307). Similarly to the processing in Step S127

shown in Fig. 14, the subscriber station device 7

generates and stores the encapsulation header from the

local tag and the remote tag in advance at the time of

the processing of Step S307, and the processing to add

5 the encapsulation header stored in advance may be

performed at the time of encapsulation of the frame.

Also, it is possible to generate the encapsulation

header by using the local tag and the remote tag in

response to the receiving of the frame.

10 [0081]

Then, the subscriber station device 7 transmits the

encapsulated main signal to the ISP side terminal device

6 (Step S309). In this case, the format of the frame

flowing from the subscriber station device 7 to the ISP

15 side terminal device 6 in Step S309 is the one shown in

Fig. 10, for instance.

[0082]

Upon receipt of the encapsulated main signal form

the subscriber station device 7, the ISP side terminal

20 device 6 performs decapsulation of the encapsulated main

signal (Step S311) and transmits the frame after

decapsulation (the same as the main signal frame

transmitted from the subscriber terminal 1 to the

subscriber side terminal device 9) toward a

25 predetermined ISP management network (a predetermined

ISP router 2a) (Step S313). By the processing of the Steps S301 - S311), the main signal frame transmitted from the subscriber terminal 1 reaches the ISP as desired via an access network 3 and can be transmitted

5   to the external network.

[0083]

On the other hand, the main signal sent from the external network such as Internet provided via connection service by ISP or from a management network

10 of ISP is supplied to the ISP side terminal device 6 via the ISP router 2a (Step S321). The ISP side terminal device 6 determines the matching of the remote tag and the local tag from the destination MAC address of the main signal frame (MAC address of the subscriber

15 terminal 1) by referring to the matching relation of the MAC address, the local tag, and the remote tag in the matching information storage means 604 (the matching information stored in Step S115 of Fig. 14) (Step S322). Then, by the frame header (encapsulation header) using

20 the local tag and the remote tag determined in Step S322, the ISP side terminal device 6 performs encapsulation of the main signal frame (Step S323) and transmits the encapsulated main signal to the subscriber station device 7 (Step S325).

25 [0084]

Similarly to the processing in Step S205 of Fig. 15, the ISP side terminal device 6 generates and stores the encapsulation header in advance from the local tag and the remote tag during the processing of Step S323. At the time of encapsulation of the frame, it may be so arranged that the encapsulation header stored in advance may be added. It is also possible to generate the encapsulation header using the local tag and the remote tag in response to the receiving of the frame. In this case, the format of the frame flowing from the ISP side terminal device 6 to the subscriber station device 7 in Step S325 is the one shown in Fig. 10, for instance.

[0085]

Upon receipt of the encapsulated main signal from the ISP side terminal device 6, the subscriber station device 7 performs decapsulation of the encapsulated main signal (Step S327). After adding the matching local tag to the subscriber terminal 1 to the frame after decapsulation (Step S329), the main signal with the local tag is transmitted to the subscriber side terminal device 9 (Step S331). Similarly to the processing in Step S211 in Fig. 15, the subscriber station device 7 can also acquire the local tag to be added to the frame after decapsulation by referring to the matching information stored in the matching information storage

means 706 during the processing of Step S329. Also, by analyzing the encapsulation header added to the encapsulated frame as received, it is also possible to acquire the local tag to be added to the frame after decapsulation. In this case, the format of the frame flowing from the subscriber station device 7 to the subscriber side terminal device 9 in Step S331 is the one shown in Fig. 9, for instance.

[0086]

Upon receipt of the main signal with the local tag from the subscriber station device 7, the subscriber side terminal device 9 removes the local tag from the received frame (Step S333), and the frame after removing the local tag (the same as the main signal frame transmitted from the ISP router 2a to the ISP side terminal device 6) to the subscriber terminal 1 as set at the destination of the ISP authentication response (Step S335). By the processing in Steps S301 - S335, the main signal frame transmitted from the ISP side can reach a predetermined subscriber terminal 1 via the access network 3. Also, when the local tag to be added to the frame after decapsulation is to be acquired, by analyzing the encapsulation header added to the encapsulated frame as received, the burden of the load of the processing of the subscriber station device 7 can

be extensively reduced in comparison with the case where

the processing to specify the local tag is performed by

referring to the matching information stored in the

matching information storage means 706. Because the

5   local tag matches the pass to ISP, the subscriber can

selectively change the ISP of connection destination by

selecting the local tag.

[0087]

Next, description will be given on an example when a

10 plurality of subscriber terminals 1 make connection to

different ISPs at the same time in the present invention.

Fig. 17 shows an example, in which connection is made to

different ISPs from a plurality of subscriber terminals

under the control of the same subscriber side terminal

15 device in the network configuration in the embodiment of

the present invention. Fig. 18 shows an example, in

which connection is made to different ISPs from a

plurality of subscriber terminals present under the

control of each of the different subscriber side

20 terminal devices in the network configuration in the

embodiment of the present invention.

[0088]

In Fig. 17 and Fig. 18, there are four subscriber

terminals 1a – 1d and two subscriber side terminal

25 devices 9a and 9b, and there are two subscriber

terminals 1a and 1b under the control of the subscriber
side terminal device 9a, and there are two subscriber
terminals 1c and 1d under the control of the subscriber
side terminal device 9b. In Fig. 17, the subscriber

5   terminal 1a is connected to the ISP closer to the ISP
router 2a and the subscriber terminal 1b is connected to
the ISP, which is closer to the ISP router 2b. In Fig.
18, the subscriber terminal 1a is connected to the ISP,
which is closer to the ISP router 2a, and the subscriber

10   terminal 1d is connected to the ISP, which is closer to
the ISP router 2b.

     [0089]

     According to the present invention, the ISP side
terminal device 6 can identify that the local tags

15   allotted to each of the plurality of subscriber
terminals 1a – 1d are different from each other.
Therefore, the ISP side terminal device 6 can uniquely
specify the destination of each of the subscriber
terminals 1a – 1d by remote tag and local tag when the

20   frame is transmitted to the downstream side. Even when a
plurality of subscriber terminals 1a and 1b under the
control of the same subscriber side terminal device 9a
as shown in Fig. 17 are connected to different ISPs, or
even when a plurality of subscriber terminals 1a – 1d

25   under the control of each of different subscriber side

terminal devices 9a and 9b as shown in Fig. 18 are

connected to different ISPs, the frames can be

transmitted from downstream side to upstream side or the

frames can be transmitted from upstream side to

5   downstream side without any trouble.

    [0090]

    Next, description will be given on a case where the

subscriber side terminal device 9 with a plurality of

subscriber terminals 1 under its control is performing

10   wireless communication with the subscriber station

device 7 and the subscriber side terminal device 9

changes the subscriber station device 7 of the

connection destination. Fig. 19 shows a condition before

the subscriber side terminal device changes the

15   subscriber station device 7 of connection destination in

the network configuration in the embodiment of the

present invention. Fig. 20 shows a condition after the

subscriber side terminal device changes the subscriber

station device 7 of connection destination in the

20   network configuration in the embodiment of the present

invention. Fig. 19 and Fig. 20 show how the subscriber

side terminal device 9 with two subscriber terminals 1a

and 1b under its control changes the connection from the

subscriber station device 7a to the subscriber station

25   device 7b.

[0091]

According to the present invention, the subscriber station devices 7a and 7b perform management of the subscriber terminals 1a and 1b to make connection with

5 ISP, and the subscriber side terminal device 9 is so arranged that a local tag is added to correspond to the connection with the ISP on 1:1 basis according to the subscriber station devices 7a and 7b. As a result, even when the subscriber side terminal device 9 moves between

10 the subscriber station devices 7a and 7b, for instance, Nomadic connection can be achieved, in which the same connectivity is maintained before and after the moving. In the switchover of connection of the subscriber station device 7 by the subscriber side terminal device

15 9, not only the moving during wireless communication but also moving caused by replacement of wired cable for wired communication is also included.

INDUSTRIAL APPLICABILITY

20 [0092]

The access network system, the subscriber station device, and network terminal device according to the present invention make it possible to achieve inexpensive and simple arrangement and high-speed

25 communication and to freely select ISP of connection

destination for each subscriber terminal while

maintaining various advantages when using VLAN, and to

ensure reliable communication between the subscriber

terminal and ISP. Further, Nomadic connection can be

5   coped with. The invention can be applied for

communication technique between the subscriber terminal

owned by subscriber and a given communication network

via an access network made up by a plurality of relay

stations.